CLAIMS

We claim:

1. A method comprising:

initiating a search for images based on at least one query keyword in a query; and

identifying, during the search, first images having associated keywords that match the query keyword and second images that contain low-level features similar to those of the first images.

2. A method as recited in claim 1, further comprising ranking the first and second images.

3. A method as recited in claim 1, further comprising presenting the first and second images.

4. A method as recited in claim 1, further comprising:

presenting the first and second images to a user; and

monitoring feedback from the user as to which of the first and second images are relevant to the query.

5. A method as recited in claim 1, further comprising:

presenting the first and second images to a user;

receiving feedback from the user as to whether the first and second images are relevant to the query; and

learning how the first and second images are identified based on the feedback from the user.

6. A method as recited in claim 1, further comprising:

presenting the first and second images to a user;

receiving feedback from the user as to which of the first and second images are relevant to the query; and

refining the search to identify additional images that contain low-level features similar to those of the images indicated by the user as being relevant to the query.

7. A method as recited in claim 1, further comprising:

presenting the first and second images to a user;

receiving feedback from the user as to which of the first and second images are relevant to the query; and

assigning a large weight to an association between the query keyword and the images deemed relevant by the user.

8. A method as recited in claim 7, further comprising grouping the low-level features of the images deemed relevant by the user.

9. A method as recited in claim 1, further comprising:

presenting the first and second images to a user;

receiving feedback from the user identifying an example image as less relevant or irrelevant to the query for refinement of the search; and

assigning a small weight to an association between the query keyword and the example image.

10. A method as recited in claim 9, further comprising identifying additional images with low-level features similar to those of the example image.

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11. A computer readable medium having computer-executable instructions that, when executed on a processor, perform the method as recited in claim 1.

12. A method comprising:

permitting entry of both keyword-based queries and content-based queries;

finding images using both semantic-based image retrieval and low-level feature-based image retrieval;

presenting the images to a user so that the user can indicate whether the images are relevant; and

conducting semantic-based relevance feedback and low-level feature-based relevance feedback in an integrated fashion.

13. A method as recited in claim 12, further comprising ranking the images.

14. A method as recited in claim 12, further comprising using images indicated as being relevant to find additional images.

15. A computer readable medium having computer-executable instructions that, when executed on a processor, perform the method as recited in claim 12.

16. A method comprising:

associating keywords with images to form keyword-image links;

assigning weights to the keyword-image links;

presenting a result set of images obtained from an image retrieval search based on a query;

receiving feedback from a user as to whether the images in the result set are relevant to the query; and

modifying the weights according to the user feedback.

17. A method as recited in claim 16, wherein the modifying comprises increasing the weight of a keyword-image link for images deemed by the user as more relevant to the query.

18. A method as recited in claim 16, wherein the modifying comprises decreasing the weight of a keyword-image link for images deemed by the user as less relevant to the query.

19. A computer readable medium having computer-executable instructions that, when executed on a processor, perform the method as recited in claim 16.

20. A method comprising:

presenting a result set of images that are returned from an image retrieval search of a query having at least one keyword;

monitoring feedback from a user as to whether the images in the result set are relevant to the query;

in an event that the user selects at least one image as being relevant to the query, associating the keyword in the query with the selected image to form a first keyword-image association and assigning a comparatively large weight to the first keyword-image association; and

in an event that the user identifies an example image for refinement of the search, associating the keyword in the query with the example image to form a second keyword-image association and assigning a comparatively small weight to the second keyword-image association.

21. A method as recited in claim 20, further comprising conducting both content-based image retrieval and semantic-based image retrieval.

22. A method as recited in claim 20, further comprising presenting the result set of images in a user interface, the user interface facilitating the user feedback by allowing the user to indicate which images are more relevant and which images are less relevant.

23. A computer readable medium having computer-executable instructions that, when executed on a processor, perform the method as recited in claim 20.

24. A method comprising:

computing, for each category, a representative feature vectors of a set of existing images within the category;

determining a set of representative keywords that are associated with the existing images in each category;

comparing, for each new image, the low-level feature vectors of the new image to the representative feature vectors of the existing images in each category to identify a closest matching category; and

labeling the new image with the with the set of representative keywords associated with the closest matching category.

25. A method as recited in claim 24, further comprising using use feedback to selectively add and/or remove keywords from the new image.

26. A method as recited in claim 24, further comprising:

placing the labeled new images into a holding category;

evaluating the labeled new images in the holding category to determine if any of the keywords associated with the labeled new image match the representative keywords from each category; and

assigning the labeled new image to the category that best matches the keywords associated with the labeled new image.

27. An image retrieval system comprising:

a query handler to handle both keyword-based queries having one or more search keywords and content-based queries having one or more low-level features of an image; and

a feature and semantic matcher to identify at least one of (1) first images having keywords that match the search keywords from a keyword-based query, and (2) second images having low-level features similar to the low-level features of a content-based query.

28. An image retrieval system as recited in claim 27, wherein the feature and semantic matcher ranks the images.

29. An image retrieval system as recited in claim 27, wherein the query handler comprises a natural language parser.

30. An image retrieval system as recited in claim 27, wherein the query handler comprises:

a parser to parse text-based queries; and

a concept hierarchy to define various categories of images.

31. An image retrieval system as recited in claim 27, further comprising a user interface to present the images identified by the feature and semantic matcher.

32. An image retrieval system as recited in claim 27, further comprising:

a user interface to present the images identified by the feature and semantic matcher to a user, the user interface allowing the user to indicate whether the images are relevant to the query; and

a feedback analyzer to train the image retrieval system based on user feedback as to relevancy.

33. An image retrieval system as recited in claim 27, further comprising:

a user interface to present the images identified by the feature and semantic matcher to a user, the user interface allowing the user to identify an example image; and

the feature and semantic matcher being configured to identify additional images that contain low-level features similar to those of the example image.

34. An image retrieval system as recited in claim 27, further comprising:

a user interface to present the images identified by the feature and semantic matcher to a user, the user interface allowing the user to identify which images are relevant to a particular search query; and

a feedback analyzer to assign a large weight to an association between the search keywords and the images identified as relevant by the user.

35. An image retrieval system as recited in claim 34, wherein the feedback analyzer groups the low-level features of the images identified as relevant by the user.

36. An image retrieval system as recited in claim 27, further comprising:

a user interface to present the images identified by the feature and semantic matcher to a user, the user interface allowing the user to identify an example image as being less relevant or irrelevant to the query; and

a feedback analyzer to assign a small weight to an association between the search keywords and the example image.

37. An image retrieval system as recited in claim 36, wherein the feature and semantic matcher identifies additional images with low-level features similar to those of the example image.

38. A database structure stored on one or more computer-readable media comprising:

multiple image files;

multiple keywords; and

a semantic network to associate the keywords with the image files, the semantic network defining individual keyword-image links that associate a particular keyword with a particular image file, each keyword-image link having a weight indicative of how relevant the particular keyword is to the particular image file.

39. A computer-readable medium having computer-executable instructions that, when executed, direct a computer to:

find images using both semantic-based image retrieval and low-level feature-based image retrieval;

present the images to a user so that the user can indicate whether the images are relevant; and

concurrently conduct semantic-based relevance feedback and low-level feature-based relevance feedback.

40. A program as recited in claim 39, further comprising computer-executable instructions that, when executed, direct a computer to rank the images.

41. An information retrieval program, embodied on the computer-readable medium, comprising the computer-executable instructions of claim 39.